Master Thesis

Uncertainty quantification of Solid Oxide Electrolyzer application

Solid Oxide Electrolyzers are considered to be the most energy-efficient electrolyzer solutions. Thus, they are essential to the production of hydrogen from renewable energy sources. However, the degradation and long-term reliability are factors that keep them from a widespread application. Therefore, the evaluation of the most critical features contributing to this is important. With the help of quantification of the uncertainties of Solid Oxide Electrolyzers (SOEC), especially compared to Solid Oxide Fuel Cells (SOFC), we would like to provide an assessment of the reliability of the systems and a suggestion for improvement.

We are searching for an M.Sc. student from engineering or materials science to develop this new research field with us. This will be part of collaborative work between the group "System Reliability, Adaptive Structures, and Machine Acoustics" (Mechanical Engineering at TU Darmstadt) and the Fraunhofer IWKS.
The student is suggested to conduct an uncertainty quantification based on available literature data. The first step would be the identification of the sources of uncertainty in comparison to SOFC. The use of appropriate models to quantify uncertainty and propagate it through the respective model should give information on the parameters the model is most sensitive to. Eventually, this leads to possible suggestions for optimization to obtain a robust system.

The student will gain in-depth knowledge about the application and working principles of SOEC. Furthermore, she/he will become proficient in uncertainty quantification. Both are rising topics in research and industry. The participating groups also offer an excellent opportunity to gain intercultural experience and be part of new high-impact research.

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Reference:

1. A. Cuneo et al, *Probabilistic analysis of a fuel cell degradation model for solid oxide fuel cell and gas turbine hybrid systems*, Energy 141 (2017) 2277-2287
2. J. Peng et al., *Comprehensive Analysis of Solid Oxide Fuel Cell Performance Degradation Mechanism, Prediction, and Optimization Studies*, Energies 16 (2023) 788